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MARKS

ARTHAM
RESOURCE MATERIAL
NO. 1 EDUCATIONAL RESOURCES

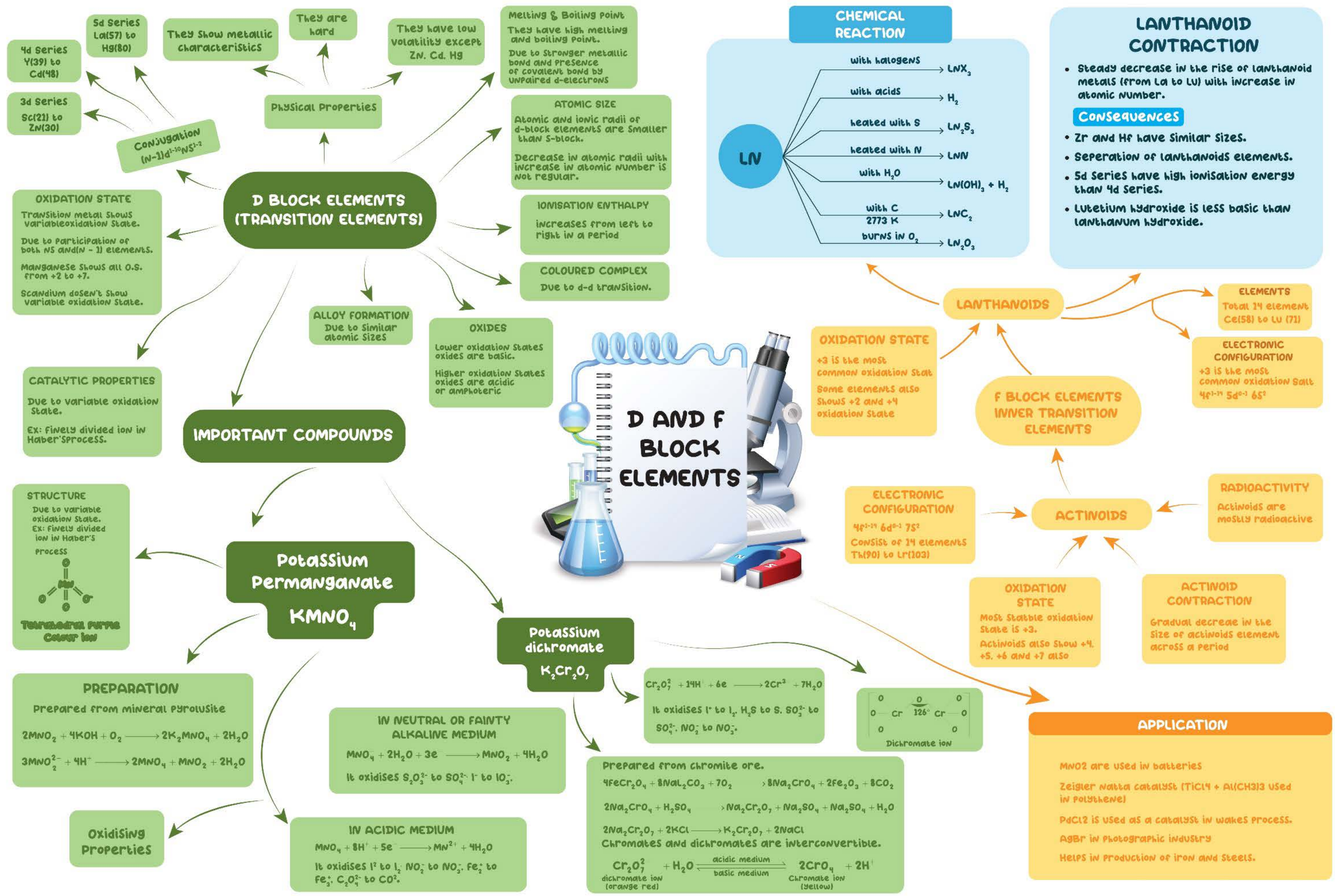
NCERT

CHAPTER WISE
TOPIC WISE

LINE BY LINE QUESTIONS

2024

BY
SCHOOL OF
EDUCATORS



D AND F BLOCK ELEMENTS

D BLOCK ELEMENTS (TRANSITION ELEMENTS)

Physical Properties

They show metallic characteristics

They are hard

They have low volatility except Zn. Cd. Hg

Melting & Boiling point

They have high melting and boiling point.

Due to stronger metallic bond and presence of covalent bond by unpaired d-electrons

ATOMIC SIZE

Atomic and ionic radii of d-block elements are smaller than s-block.

Decrease in atomic radii with increase in atomic number is not regular.

IONISATION ENTHALPY

increases from left to right in a period

COLOURED COMPLEX

Due to d-d transition.

OXIDES

Lower oxidation states oxides are basic.

Higher oxidation states oxides are acidic or amphoteric

ALLOY FORMATION

Due to similar atomic sizes

Conjugation

$(n-1)d^{1-10}ns^{1-2}$

3d series Sc(21) to Zn(30)

4d series Y(39) to Cd(48)

5d series La(57) to Hg(80)

OXIDATION STATE

Transition metal shows variableoxidation state.

Due to participation of both ns and(n - 1) elements.

Manganese shows all O.S. from +2 to +7.

Scandium dosen't show variable oxidation state.

CATALYTIC PROPERTIES

Due to variable oxidation state.

Ex: Finely divided ion in Haber'sprocess.

IMPORTANT COMPOUNDS

Potassium Permanganate $KMnO_4$

STRUCTURE

Due to variable oxidation state.
Ex: Finely divided ion in Haber's process

Tetrahedral Purple Colour ion

PREPARATION

Prepared from mineral pyrolusite

$2MnO_2 + 4KOH + O_2 \longrightarrow 2K_2MnO_4 + 2H_2O$

$3MnO_2^{2-} + 4H^+ \longrightarrow 2MnO_4 + MnO_2 + 2H_2O$

Oxidising Properties

IN NEUTRAL OR FAINTY ALKALINE MEDIUM

$MnO_4 + 2H_2O + 3e^- \longrightarrow MnO_2 + 4H_2O$

It oxidises $S_2O_3^{2-}$ to SO_4^{2-}. I^- to IO_3^-.

IN ACIDIC MEDIUM

$MnO_4 + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$

It oxidises I^2 to I_2. NO_2^- to NO_3^-. Fe_2^+ to Fe_3^+. $C_2O_4^{2-}$ to CO^2.

Potassium dichromate $K_2Cr_2O_7$

$Cr_2O_7^2 + 14H^+ + 6e \longrightarrow 2Cr^3 + 7H_2O$

It oxidises I^+ to I_2. H_2S to S. SO_3^{2-} to SO_4^{2-}. NO_2^- to NO_3^-.

Dichromate ion

Prepared from chromite ore.

$4FeCr_2O_4 + 8NaL_2CO_3 + 7O_2 \longrightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$

$2Na_2CrO_4 + H_2SO_4 \longrightarrow Na_2Cr_2O_7 + Na_2SO_4 + Na_2SO_4 + H_2O$

$2Na_2Cr_2O_7 + 2KCl \longrightarrow K_2Cr_2O_7 + 2NaCl$

Chromates and dichromates are interconvertible.

$\underset{\text{dichromate ion (orange red)}}{Cr_2O_7^2} + H_2O \underset{\text{basic medium}}{\overset{\text{acidic medium}}{\rightleftharpoons}} \underset{\text{Chromate ion (Yellow)}}{2CrO_4} + 2H^+$

F BLOCK ELEMENTS INNER TRANSITION ELEMENTS

LANTHANOIDS

OXIDATION STATE

+3 is the most common oxidation stat

Some elements also shows +2 and +4 oxidation state

ELEMENTS

Total 14 element Ce(58) to Lu (71)

ELECTRONIC CONFIGURATION

+3 is the most common oxidation salt

$4f^{1-14}\ 5d^{0-1}\ 6s^2$

CHEMICAL REACTION

Ln with halogens → LnX_3

with acids → H_2

heated with S → Ln_2S_3

heated with N → LnN

with H_2O → $Ln(OH)_3 + H_2$

with C 2773 K → LnC_2

burns in O_2 → Ln_2O_3

LANTHANOID CONTRACTION

- Steady decrease in the rise of lanthanoid metals (from La to Lu) with increase in atomic number.

Consequences

- Zr and Hf have similar sizes.
- Seperation of lanthanoids elements.
- 5d series have high ionisation energy than 4d series.
- Lutetium hydroxide is less basic than lanthanum hydroxide.

ACTINOIDS

ELECTRONIC CONFIGURATION

$5f^{1-14}\ 6d^{0-1}\ 7s^2$

Consist of 14 elements Th(90) to Lr(103)

RADIOACTIVITY

Actinoids are mostly radioactive

OXIDATION STATE

Most statble oxidation state is +3.

Actinoids also show +4. +5. +6 and +7 also

ACTINOID CONTRACTION

Gradual decreae in the size of actinoids element across a period

APPLICATION

MnO2 are used in batteries

Zeigler Natta catalyst (TiCl4 + Al(CH3)3 used in polythene)

PdCl2 is used as a catalyst in wakes process.

AgBr in photographic industry

Helps in production of iron and steels.

NCERT LINE BY LINE QUESTIONS

08. THE D- & F-BLOCK ELEMENTS

(1.) Among the transition metals of 3d-series, the one that has the highest negative M^{2+}/M standard electrode potential is

(a.) Ti (b.) Cu

(c.) Mn (d.) Ni

(2.) Compute the given reaction of $KMnO_4$ in acidic medium:

$5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O + 5X$

$5S^{2-} + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5Y$

$ZNO_2^- + 2MnO_4^- + 6H^+ \rightarrow 2Mn^{2+} + ZNO_3^- + 3H_2O$

X, Y and Z are respectively

(a.) $Fe, S^{2+}, 6$ (b.) $Fe^{3+}, S, 7$

(c.) $Fe^{3+}, S, 5$ (d.) $Fe^{2+}, S^{2+}, 5$

(3.) Solution of oxalate is colourless. It is made acidic by adding exceeds of H^+, then titrated with $KMnO_4$. Now at a moment if someone has added large amount of $KMnO_4$ in it then the possible products are

(a.) CO_2, Mn^{2+}, H_2O (b.) CO_2, MnO_2, H_2O

(c.) MnO_2, H_2O, CO_2 (d.) $CO_2, MnO_{2f} H_2O, Mn^{2+}$

(4.) Which of the comparison regarding Zn, Cd, Hg is/ are incorrect〉.

I $ZnCl_2$ is ionic whereas $CdCl_2$ and $HgCl_2$ are covalent.

II Zn and Cd dissolves in dilute acid (HCl) liberating H_2 but Hg cannot.

III Zn and Cd forming white ppt. of $Zn(OH)_2$ and $Cd(OH)_2$ but Hg form coloured ppt. of $Hg(OH)_2$.

(a.) I & III (b.) I & II

(c.) II & III (d.) only I

(5.) The silver UK coins are

(a.) Cu / Zn alloy (b.) Cu / Ni alloy

(c.) Ag / Ni alloy (d.) Ag / Au alloy.

(6.) Match the following.

(P) Radioactive lanthanoid	(I) Eu
(Q) Lanthanoid which has $4f^7$ in $+2$ oxidation state	(II) La
(R) Lanthanoid which has $4f^7$ in $+3$ oxidation state	(III) Pm
(S) Lanthanoid which has $4f^0$ in $+3$ oxidation state	(IV) Gd

(a.) P-III,Q-I,R-IV,S-II
(b.) P-III,Q-IV,R-I,S-II
(c.) P-I,Q-IILR-IV,S-II
(d.) P-II,Q-III,R-IV,S-I

(7.) The melting point of copper is higher than that of zinc because
(a.) the atomic structure of copper is much denser than zinc
(b.) the atomic volume of copper is high
(c.) involvement of lesser number of electrons in metallic bonding
(d.) involvement of $(n-1)$ d electrons in metallic bonding.

(8.) What happens when KCl is heated with H_2SO_4 and potassium dichromate?
(a.) CrO_2Cl_2 is formed.
(b.) $CrCl_3$ is formed.
(c.) K_2CrO_4 is formed.
(d.) $Cr_2(SO_4)_3$ is formed.

(9.) Consider the given statements:
I In its higher oxidation states, manganese forms stable compounds with oxygen and fluorine.
II Mn^{3+} and Co^{3+} are oxidising agents in aqueous solution.
III Ti^{2+} and Cr^{2+} are reducing agents in aqueous solution.
Which of the given statement(s) is/are correct
(a.) I only
(b.) I & II only
(c.) II & III only
(d.) all of these

(10.) Electronic configuration of Cu is given as $[Ar]\ 3d^{10}4s^2$. Then which of the following is correct about $Cu(I)$ and $Cu(II)$?
(a.) E.C. of $Cu(I)$ is $3d^9$ and $Cu(II)$ is $3d^{10}$.
(b.) $Cu(II)$ is more stable than $Cu(I)$.
(c.) $Cu(I)$ and $Cu(II)$ are equally stable.
(d.) Stability of $Cu(I)$ and $Cu(II)$ depends on nature of copper salts.

(11.) **Assertion:** The highest oxidation state of osmium is $+6$.
Reason: Osmium is a 6d-block element.
(a.) Both A and R are correct and R is correct explanation of A.
(b.) Both A and R are correct but R is not correct explanation of A.
(c.) A is true but R is false.
(d.) Both A and R are false.

(12.) **Assertion:** Separation of Zr and Hf is difficult.
Reason: Both have same chemical properties due to similar radius
(a.) Both A and R are correct and R is correct explanation of A.
(b.) Both A and R are correct but R is not correct explanation of A.
(c.) A is true but R is false.
(d.) Both A and R are false.

(13.) The separation of lanthanides by ion exchange method is based on
(a.) size of the ions
(b.) the solubility of their nitrates
(c.) oxidation states of the ions
(d.) basicity of the hydroxides of lanthanides.

(14.) Which of the following ions show higher spin only magnetic moment value
(a.) Ti^{3+} & Mn^{2+}
(b.) Mn^{2+} & Ti^{3+}

(c.) Mn^{2+} & Fe^{2+}

(d.) Co^{3+} & Mn^{2+}

(15.) Manganese exhibit its highest oxidation state $(+7)$ in its oxide not in its fluoride, why.

(a.) Oxygen is less electronegative than fluorine.

(b.) Oxygen posses d-orbitals while fluorine does nor.

(c.) Fluorine stabilises lower oxidation state.

(d.) In covalent compounds fluorine can form single bond only while oxygen forms double bonds.

(16.) Which of the following factors is responsible for the value of ionisation enthalpy.

(a.) Attraction of each electron towards nucleus

(b.) Repulsion between the electrons

(c.) Exchange energy

(d.) All of these

(17.) Transition elements show magnetic moment due to presence of unpaired electrons. Which of the following pairs have same magnetic moment?

(a.) Co^{2+}, Cr^{2+},

(b.) Cr^{2+}, Mn^{2+}

(c.) Mn^{2+}, Cr^{3+}

(d.) Co^{2+}, Cr^{3+}

(18.) When a mixture of $NaCl$ and $K_2Cr_2O_7$ is gently warmed with contracted H_2SO_4, then

(I) Chlorine gas is evolved
(II) Orange red vapours are evolved
(III) The vapours when passed into $NaOH$ solution give a yellow solution of Na_2CrO_4
Which of the following is/are correct

(a.) I only

(b.) II & III

(c.) I & III

(d.) All are correct

(19.) The reason for greater range of oxidation stare in actinoids is attributed to

(a.) the radioactive nature of actinoids

(b.) actinoid contraction

(c.) 5f, 6d and 7s levels having comparable energies

(d.) 4f and 5d levels being close in energies.

(20.) General electronic configuration of lanthanoids is

(a.) $(n-2)f^{1-14}(n-1)s^2p^6d^{0-1}ns^2$

(b.) $(n-2)f^{10-14}(n-1)d^{0-1}ns^2$

(c.) $(n-2)f^{0-14}(n-1)d^{10}ns^2$

(d.) $(n-2)d^{0-1}(n-1)f^{1-14}ns^2$

(21.) **Assertion:** Potassium dichromate is used as a primary standard in volumetric analysis.
Reason: Sodium and potassium dichromates are strong oxidising agents.

(a.) Both A and R are correct and R is correct explanation of A.

(b.) Both A and R are correct but R is nor correct explanation of A.

(c.) A is true but R is false.

(d.) Both A and R are false.

(22.) Match the catalysts with the processes.

(i) Ni/H_2	(P) Reaction between iodide and persulphate ions

(ii) Cu_2Cl_2	(Q) Vegetable oil to ghee
(iii) Fe (III)	(R) Sandmeyer reaction
(iv) Finely divided Fe	(S) Haber’s process

(a.) (i)-Q, (ii)-P, (iii)-S, (iv)-R
(b.) (i)-P, (ii)-Q, (iii)-S, (iv)-R
(c.) (i)-P, (ii)-R, (iii)-Q, (iv)-S
(d.) (i)-Q, (ii)-R, (iii)-P, (iv)-S

(23.) Which of the following elements shows maximum number of different oxidation states in its compounds?

(a.) Eu
(b.) La
(c.) Gd
(d.) Am

(24.) Which of the following are radioactive?

(a.) Tb & Pm
(b.) Pm & Pa
(c.) Am & Tb
(d.) Pa & Am

(25.) Which of the following is correct about reaction of $KMnO_4$ with oxalic acid?

(a.) CO_2 is formed as the product.
(b.) The decolourisaton of $KMnO_4$ is slow in the beginning and become instantaneous after sometime.
(c.) Mn^{2+} catalyses the reaction.
(d.) All of these

(26.) The colour of $KMnO_4$ is due to

(a.) $L \rightarrow M$ charge transfer
(b.) $\sigma \rightarrow \sigma^*$ transition
(c.) $M \rightarrow L$ charge transfer
(d.) d - d transition.

(27.) Actinoids are generally slightly affected by HNO_3 but HCl attacks almost all metals because

(a.) HCl is stronger acid than HNO_3
(b.) HNO_3 is stronger acid than HCl
(c.) formation of protective oxide layer by HNO_3
(d.) formation of protective oxide layer by HCl.

(28.) Reduction of metal centre in aqueous permanganate ion involves

I 3 electrons in neutral medium
II 5 electrons in acidic medium
III 1 electron in alkaline medium

Which of the following is/are correct

(a.) Only II
(b.) II & III
(c.) I & II
(d.) All of these

(29.) The reason behind the same physical and chemical properties of zirconium (4d – series) and hafnium (5d – series) is

(a.) same number of valence electrons
(b.) same value of electrode potential
(c.) almost similar atomic radius
(d.) same enthalpy of atomisation.

(30.) When neutral or faintly alkaline $KMnO_4$ is treated with potassium iodide, iodide ion is converted into X. X is

(a.) IO

(b.) I_2

(c.) IO_4

(d.) IO_3

(31.) The electronic configuration of Eu (Atomic no. 63), Gd (Atomic no. 64) and Tb (Atomic no. 65) are

(a.) $[Xe]\ 4f^7 6s^2, [Xe] 4f^8 6s^2 \text{and} [Xe] 4f^8 5d^1 6s^2$

(b.) $[Xe]\ 4f^6 5d^1 6s^2, [Xe] 4f^7 5d^1 6s^2 \text{and} [Xe] 4f^9 6s^2$

(c.) $[Xe]\ 4f^6 5d^1 6s^2, [Xe] 4f^7 5d^1 6s^2 \text{and} [Xe] 4f^8 5d^1 6s^2$

(d.) $[Xe]\ 4f^7 6s^2, [Xe] 4f^7 5d^1 6s^2 \text{and} [Xe] 4f^{9}{}’6s^2$

(32.) Which of the following is not correctly matched with $K_2Cr_2O_7$ reactions?

(a.) $I^- \to I_2$

(b.) $Sn^{2+} \to Sn^{3+}$

(c.) $H_2S \to S$

(d.) $Fe^{2+} \to \Gamma e^{3+}$

(33.) The magnetic moment of a divalent ion in aqueous solution if its atomic number is 27, is

(a.) 3.87 B.M .

(b.) 5.90 B.M

(c.) 4.89 B.M .

(d.) 2.9 B.M.

(34.) March the following columns.

(P) Reagent oxidised Fe^{2+} to Fe^{3+}	(i) K_2MnO_4
(Q) Compound having dark purple crystal isostructure with $KClO_4$	(ii) $KMnO_4$
(R) Green compound formed by fusing KOH with MnO_2	(iii) $K_2Cr_2O_7$
(S) Compound which has orange crystal tetrahedral structure acidified	(iv) $KMnO_4$

(a.) P-(iv) , Q-(ii) , R-(i) , S-(iii)

(b.) P-(iii) , Q-(ii) , R-(i) , S-(iv)

(c.) P-(iv) , Q-(i) , R-(ii) , S-(iii)

(d.) P-(iii) , Q-(i) , R-(ii) , S-(iv)

(35.) **Assertion:** $KMnO_4$ is used for bleaching wool, cotton, silk and other textile fibres and for decolourisation of oils.

Reason: $KMnO_4$ is a strong oxidising agent.

(a.) Both A and R are correct and R is correct explanation of A.

(b.) Both A and R are correct but R is not correct explanation of A.

(c.) A is true but R is false.

(d.) Both A and R are false.

(36.) Which one of the following statements related to lanthanoids is incorrect?

(a.) Europium shows $+2$ oxidation state.

(b.) The basicity decrease as the ionic radius decreases from Pr to Lu.

(c.) All the Lanthanons are much more reactive

(d.) $Ce(+4)$ solutions are widely used as oxidising than aluminum.

agent in volumetric analysis.

(37.) Among the following pairs of ions, the lower oxidation state in aqueous solution is more stable than the other, in

(a.) Ti^{+}, Ti^{3+}
(b.) Cu^{+}, Cu^{2+}
(c.) Cr^{2+}, Cr^{3+}
(d.) V^{2+}, VO^{2+}

(38.) Among $Sc(III)$, $Ti(IV)$, $Pd(II)$ and $Cu(II)$ ions

(a.) all are paramagnetic
(b.) all the diamagnetic
(c.) $Sc(III)$, $Ti(IV)$ are paramagnetic and $Pd(II)$ and $Cu(II)$ are diamagnetic
(d.) $Sc(III)$, $Ti(IV)$ are diamagnetic and $Pd(II)$ and $Cu(II)$ are paramagnetic.

(39.) The reason for lanthanoid contraction is

(a.) greater shielding of 4f - electrons
(b.) poor shielding of 4f - electrons
(c.) greater shielding of 5d - electrons
(d.) poor shielding of 5d - electrons.

(40.) Correct set of amphoteric oxides is

(a.) V_2O_5, Cr_2O_3
(b.) CrO, V_2O_5
(c.) V_2O_4, CrO_3
(d.) Mn_2O_7, CrO_3

(41.) The composition of Mischmetal is

(a.) Lanthanoid metals $(-90) + Fe(-9.5\%) + S, C, Ca, Al$
(b.) Lanthanoid metals $(-95) + Fe(-5\%) + S, C, Ca, Al$
(c.) Lanthanoid metals $(90\%) +$ Actinoids $(5\%) + C(5\%)$
(d.) Lanthanoid metals $(95\%) + C\ (5\%) + Fe,\ S, Al$

(42.) Which of the following reaction of $KMNO_4$ represent disproportionation .

(a.) $3MnO_4^{2-} + 4H^{+} \rightarrow 2MnO_4^{-} + MnO_2 + 2H_2O$
(b.) $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$
(c.) $2MnO_4^{-} + 3Mn^{2+} + 2H_2O \rightarrow 5MnO_2 + 4H^{+}$
(d.) All of these

(43.) Which of the following actinoids have $6d^1$ in their electronic configuration.

(a.) U, Pa, Cm
(b.) U, Th, Fm
(c.) Th, Pa, Md
(d.) Cm, Fm, No

(44.) Stability of Fe^{3+} compounds is much more than stability of Fe^{2+} compounds. The correct reason form this is

(a.) ionic radius of Fe^{3+} is smaller
(b.) Fe^{3+} undergo disproportionauion
(c.) Fe^{3+} has lower reduction potential
(d.) Fe^{3+} has stable d^5 configuration.

(45.) **Assertion:** 5f electrons are more effectively shielded from the nuclear charge than the 4f - electrons of the corresponding lanthanoids.

Reason: The outer electrons are less firmly held.

(a.) Both A and R are correct and R is correct explanation of A.

(b.) Both A and R are correct but R is not correct explanation of A.

(c.) A is true but R is false.

(d.) Both A and R are false.

(46.) Which of the following elements will form MF_3 type compounds

(a.) Cr & Ni

(b.) Cr & Cu

(c.) Co & Cu

(d.) Cr & Co

(47.) Which of the following is not correctly matched for $KMnO_4$?

(a.) In acidic medium, $I^- \rightarrow I_2$

(b.) In neutral medium, $S_2O_3^{2-} \rightarrow SO_4^{2-}$

(c.) In acidic medium, $S^2 \rightarrow SO_4^{2-}$

(d.) In neutral medium, $Mn^{2+} \rightarrow MnO_2$

(48.) The correct reason for lanthanoid contraction is

(a.) imperfect shielding effect of f-orbitals

(b.) increasing nuclear charge

(c.) decreasing nuclear charge

(d.) decreasing in metallic radius.

(49.) Match the following.

Column I	**Column II**
(Compounds/elements)	**(Use)**
(P) Lanthanoid oxide	(I) Lighter flint
(Q) Mg based alloy	(II) Alloy steel
(R) Mixed oxides of lanthanoids	(III) Television screen
(S) Lanthanoids	(IV) Petroleum cracking

(a.) P-III,Q-I, R-IV,S-II

(b.) P-III,Q-II, R-I,S-IV

(c.) P-II,Q-IV, R-III,S-I

(d.) P-I,Q-III, R-II,S-IV

(50.) Which is not true about lanthanoids?

(a.) All the lanthanoids are silvery white soft metals and tarnish rapidly in air.

(b.) All lanthanoids are highly dense metals.

(c.) Lanthanides are separated from one another by ion exchange methods.

(d.) The hardness decreases with increasing atomic number, samarium being steel hard.

TOPIC WISE PRACTICE QUESTIONS

TOPIC 1: Characteristics of d-Block Elements

1. Which of the following is not a condition for complex formation?
1) Small atomic size 2) High nuclear charge
3) Variable oxidation states 4) Availability of vacant *d* orbitals

2. The stability of particular oxidation state of a metal in aqueous solution is determined by
1) enthalpy of sublimation of the metal 2) ionisation energy
3) enthalpy of hydration of the metal ion 4) all of these

3. In general, the melting and boiling points of transition metals
1) increases gradually across the period from left to right.
2) decreases gradually across the period from left to right.
3) first increases till the middle of the period and then decreases towards the end.
4) first decreases regularly till the middle of the period and then increases towards the end.

4. Which of the following is used in the preparation of chlorine?
1) Only MnO_2 2) Only $KMnO_4$
3) BothMnO_2 and $KMnO_4$ 4) Either MnO_2 or $KMnO_4$

5. Chloro compound of vanadium has only spin magnetic moment of 1.73 BM. This vanadium chloride has the formula:
1) VCl_2 2) VCl_4 3) VCl_3 4) VCl_5

6. The aqueous solution containing which one of the following ions will be colourless? (Atomic number: Sc = 21, Fe = 26, Ti = 22, Mn = 25).
1) Sc^{3+} 2) Fe^{2+} 3) Ti^{3+} 4) Mn^{2+}

7. Among the transition elements the element with lowest melting point belongs to
1) Group 3 2) Group 11 3) Group 6 4) Group 12

8. Which of the following ions does not liberate hydrogen gas on reaction with dilute acids ?
1) Ti^{2+} 2) V^{2+} 3) Cr^{2+} 4) Mn^{2+}

9. Which one of the following species is stable in aqueous solution ?
1) Cr^{2+} 2) MnO_4^{2-} 3) MnO_4^{3-} 4) Cu^+

10. Which transition metal has lowest density?
1) Sc 2) Ti 3) Zn 4) La

11. Which of the following ions has the maximum magnetic moment?
1) Mn^{+2} 2) Fe^{+2} 3) Ti^{+2} 4) Cr^{+2}

12. The maximum oxidation state shown by V (Z = 23), Cr (Z = 24), Co (Z = 27), Sc (Z = 21) are respectively
1) +5, +6, +2, +3 2) +3, +4, +5, +2 3) +5, +3, +2, +1 4) +4 in each case

13. Which of the following pairs has the same size?
1) Fe^{2+} , Ni^{2+} 2) Zr^{4+} , Ti^{4+} 3) Zr^{4+} , Hf^{4+} 4) Zn^{2+} , Hf^{4+}

14. Of the following elements which is *not* expected to displayan oxidation state of +6 in any of its compounds?
1) Ti 2) Cr 3) Mn 4) W

15. Which one of the following does not correctly represent the correct order of the property indicated against it?
1) Ti < V < Cr < Mn : increasing number of oxidation states
2) $Ti^{3+} < V^{3+} < Cr^{3+} < Mn^{3+}$: increasing magnetic moment
3) Ti < V < Cr < Mn : increasing melting points
4) Ti < V < Mn < Cr : increasing 2nd ionization enthalpy

16. Four successive members of the first series of the transition metals are listed below. For which one of them the standard potential $\left(E^0_{M^{2+}/M}\right)$ value has a positive sign?
1) Co (Z = 27) 2) Ni (Z = 28) 3) Cu (Z = 29) 4) Fe (Z = 26)

17. The catalytic activity of transition metals and their compounds is mainly due to

1) their magnetic behaviour 2) their unfilled *d*-orbitals
3) their ability to adopt variable oxidation state 4) their chemical reactivity

18. Which of the following has the maximum number of unpaired electrons?
1) Ti^{2+} 2) Fe^{2+} 3) Cr^{+} 4) Cu^{+}

19. Which of the following species is/are paramagnetic?
Fe^{2+}, Zn^{0}, Hg^{2+}, Ti^{4+}
1) Fe^{2+} only 2) Zn^{0} and Ti^{4+} 3) Fe^{2+} and Hg^{2+} 4) Zn^{0} and Hg^{2+}

20. A compound of a metal ion M^{x+} (Z = 24) has a spin only magnetic moment of $\sqrt{15}$ Bohr Magnetons. The number of unpaired electrons in the compound are
(a) 2 2) 4 3) 5 4) 3

TOPIC 2: Compounds of Transition Metals

21. From a solution $CuSO_4$, the metal used to recover copper is
1) Na 2) Ag 3) Hg 4) Fe

22. Anhydrous cobalt (II) chloride is blue in colour but on dissolving in water it changes to pink in colour because :
1) Its oxidation state changes. 2) It magnetic character changes.
3) Its coordination number changes. 4) In water it shows fluorescence.

23. Which of the following can be employed for the conversion of potassium manganate to potassium permanganate?
1) O_3 2) Cl_2 3) Electrolysis 4) All

24. In vapour state $Cu(NO_3)_2$ and $Cu_2(CH_3COO)_4 . 2H_2O$ exist as :
1) Dimer, monomer 2) Monomer, dimer
3) Monomer, monomer 4) Dimer, Dimer

25. Which of the following is **false**?
1) Molten lead and zinc are miscible. 2) Silver is more soluble in molten zinc than lead.
3) Zinc-silver alloy is volatile. 4) Zinc-silver alloy is heavier and gets solidified later than lead.

26. Which of the following is used as purgative in medicine?
1) $ZnCl_2$ 2) $HgCl_2$ 3) Hg_2Cl_2 4) $ZnSO_4 . 7H_2O$

27. Mercury is the only metal which is liquid at 0°C. This is due to its :
1) Very high ionisation energy and weakly metallic bond. 2) Low ionisation potential.
3) High atomic weight. 4) High vapour pressure.

28. Which compound is formed when iron reacts with carbon?
1) FeC_2 2) Fe_3C 3) FeC_3 4) Fe_2C

29. The aqueous solution of transition metal salt changes colour from pink to blue, when concentrated hydrochloric acid is added to it. The change in colour is due to
1) evolution of hydrogen that changes the oxidation state of the metal ion.
2) change in the coordination number of the metal ion from 6 to 4 and formation of new species in solution.
3) formation of a coordination complex of the metal ion with hydrochloric acid.
4) protonation of the metal ion.

30. Choose the correct increasing order of the oxidation state of the central metal atom in the following oxoanions.
$VO_2^{+}, VO^{2+}, TiO^{2+}, CrO_4^{2-}$
1) $VO^{2+} \square VO_2^{+} < TiO^{2+} < CrO_4^{2-}$ 2) $VO^{2+} \square TiO^{2+} < VO_2^{+} < CrO_4^{2-}$
3) $CrO_4^{2-} < TiO^{2+} < VO_2^{+} < VO^{2+}$ 4) $TiO^{2+} < VO^{2+} \square VO_2^{+} < CrO_4^{2-}$

31. The oxoanion in which the oxidation state of the central atom is same as its group number in the periodic table is:
1) SO_4^{2-} 2) VO_2^{-} 3) MnO_4^{2-} 4) $Cr_2O_7^{2-}$

32. The acidic, basic or amphoteric nature of Mn_2O_7, V_2O_5 and CrO are respectively
1) acidic, acidic and basic 2) basic, amphoteric and acidic
3) acidic, amphoteric and basic 4) acidic, basic and amphoteric

33. When concentrated HCl is added to an aqueous solution of $CoCl_2$, its colour changes from reddish pink to deep blue. Which complex ion gives blue colour in this reaction?
1) $[CoCl_4]^{2-}$ 2) $[CoCl_6]^{3-}$ 3) $[CoCl_6]^{4-}$ 4) $[Co(H_2O)_6]^{2+}$

34. Colourless solutions of the following four salts are placed separately in four different test tubes and a strip of copper is dipped in each one of these. Which solution will turn blue?
1) KNO_3 2) $AgNO_3$ 3) $Zn(NO_3)_2$ 4) $ZnSO_4$

35. Which of the following oxides of Cr is amphoteric
1) $Cr\ O_2$ 2) Cr_2O_3 3) CrO_5 4) CrO_3

36. Among the following, the compound that is both paramagnetic and coloured, is
1) $KMnO_4$ 2) CuF_2 3) $K_2Cr_2O_7$ 4) All are coloured

37. $K_2Cr_2O_7$ on heating with aqueous NaOH gives
1) CrO_4^{2-} 2) $Cr(OH)_3$ 3) $Cr_2O_7^{2-}$ 4) $Cr(OH)_2$

38. What would happen when a solution of potassium chromate is treated with an excess of dilute nitric acid?
1) $Cr_2O_7^{2-}$ and H_2O are formed
2) CrO_4^{2-} is reduced to +3 state of cr
3) CrO_4^{2-} is oxidized to +7 state of Cr
4) Cr^{3+} and $Cr_2O_7^{2-}$ are formed

39. The oxidation state of chromium in the final product formed by the reaction between KI and acidified potassium dichromate solution is:
1) + 3 2) + 2 3) + 6 4) + 4

40. The final products formed on the addition of KI to copper sulphate solution are :
1) K_2SO_4, CuI_2 and I_2 2) K_2SO_4, Cu_2I_2 and I_2 3) K_2SO_4 and Cu_2O 4) K_2SO_4, CuO and I_2

41. $KMnO_4$ (acidic/alkaline) is not decolourised by
1) mohr salt 2) oxalic acid 3) benzene 4) propene

42. Acidified $K_2Cr_2O_7$ solution turns green when Na_2SO_3 is added to it. This is due to the formation of :
1) $Cr_2(SO_4)_3$ 2) CrO_4^{2-} 3) $Cr_2(SO_3)_3$ 4) $CrSO_4$

43. $KMnO_4$ can be prepared from K_2MnO_4 as per the reaction:

$$3MnO_4^{2-} + 2H_2O \rightleftharpoons 2MnO_4^{2-} + MnO_2 + 4OH^-$$

The reaction can go to completion by removing OH^- ions by adding.
1) KOH 2) CO_2 3) SO_2 4) HCl

44. In the laboratory, manganese (II) salt is oxidised to permanganate ion in aqueous solution by
1) hydrogen peroxide 2) conc. nitric acid
3) peroxy disulphate 4) dichromate

45. The starting material for the manufacture of $KMnO_4$ is
1) pyrolusite 2) manganite 3) magnatite 4) haematite

46. Match the columns

Column-I	**Column -II**
1) Metal of the 3*d*-series which does not form MO type oxide.	(p) Manganese
2) Metal of the 3*d*-series which forms most covalent oxide.	(q) Vanadium
3) Metal of the 3*d*-series which forms the amphoteric oxide.	(r) Scandium

1) A – (p), B – (r), C – (q) 2) A – (r), B – (p), C – (q)
3) A – (r), B – (q), C – (p) 4) A – (q), B – (p), C – (r)

47. Which one of the following is an amphoteric oxide ?
(i) Mn_2O_7 (ii) CrO (iii) V_2O_4 (iv) Cr_2O_3
1) (i) and (ii) 2) (ii), (iii) and (iv) 3) (iii) and (iv) 4) (ii) and (iv)

48. Dichromate [Cr(VI)] is a strong oxidizing agent whereas Mo(VI) and W(VI) are found to be not. This is due to
1) Lanthanoid contraction 2) Down the group metallic character increases
3) Down the group metallic character decreases 4) Both 1) and 2)

49. Which of the following conversions can be carried out by both acidified $K_2Cr_2O_4$ and acidified $KMnO_4$?
(i) $Fe^{2+} \rightarrow Fe^{3+} + e^{-}$ (ii) $I^{-} \rightarrow$ (iii) $I^{-} \rightarrow I_2$ (iv) $H_2S \rightarrow S$
1) (i) and (iii) 2) (ii) and (iv) 3) (i), (iii) and (iv) 4) (i), (ii) and (iii)

50. Which ion is not coloured?
1) $Ni(DMG)_2$ 2) $[Co(SCN)_4]^{2-}$ 3) $[Fe(H_2O)_5SCN]^{2+}$ 4) $[Al(OH)_4]^{-}$

TOPIC 3: Lanthanoids and Actinoids

51. The radius of La^{3+} (Z = 57) is 106 pm. Which one of the following given values will be closest to the radius of Lu^{3+} (Z = 71)?
1) 160 pm 2) 140 pm 3) 106 pm 4) 85 pm

52. Which of the following oxidation states is the most common among the lanthanoids?
1) 3 2) 4 3) 2 4) 5

53. What is the percentage of lanthanoid metal in mischmetall?
1) 90% 2) 20% 3) 5% 4) 95%

54. Among the lanthanoids, the one obtained by synthetic method is
1) Lu 2) Pm 3) Pr 4) Gd

55. Which one of the following elements shows maximum number of different oxidation states in its compounds?
1) Eu 2) La 3) Gd 4) Am

56. Which of the following factors may be regarded as the main cause of lanthanoid contraction?
1) Greater shielding of 5*d* electrons by 4*f* electrons
2) Poorer shielding of 5*d* electrons by 4*f* electrons
3) Effective shielding of one of 4*f* electrons by another in the subshell
4) Poor shielding of one of 4*f* electron by another in the Subshell

57. The heaviest atom amongst the following is
1) uranium 2) radium 3) lead 4) mercury

58. Although + 3 is the characteristic oxidation state for lanthanoids but cerium also shows + 4 oxidation state because __________ .
(i) it has variable ionisation enthalpy
(ii) it has a tendency to attain noble gas configuration
(iii) it has a tendency to attain *f* 0 configuration
(iv) it resembles Pb^{4+}
1) (ii) and (iii) 2) (i) and (iv) 3) (ii) and (iv) 4) (i), (ii) and (iii)

59. Which of the following exhibit only + 3 oxidation state ?
1) U 2) Th 3) Ac 4) Pa

60. Which of the following is the use of mischmetall ?
1) In bullets 2) In lighter flint 3) As catalyst in petroleum cracking 4) Both 1) and 2)

61. The approximate percentage of iron in mischmetal is
1) 10 2) 20 3) 50 4) 5

62. Gun metal is an alloy of
1) Cu and Al 2) Cu and Sn 3) Cu, Zn and Sn 4) Cu, Zn and Ni

63. Brass is an alloy of
1) Zn and Sn 2) Zn and Cu 3) Cu, Zn and Sn 4) Cu and Sn

64. Which one of the following is coinage metal ?
1) Zn 2) Cu 3) Sn 4) Pb.

65. Cerium (Z = 58) is an important member of lanthanides. Which of the following statements about cerium is *not* correct?
1) The common oxidation states of Ce are + 3 and + 4.

2) + 3 oxidation state is more stable than + 4 oxidation state.
3) + 4 oxidation state is not known in solution.
4) Ce (IV) acts as an oxidising agent.

66. Non-lanthanoid atom is
1) La 2) Lu 3) Pr 4) Pm

67. Which of the following lanthanoid ions is diamagnetic?
(At nos. Ce = 58, Sm = 62, Eu = 63, Yb = 70)
1) Sm^{2+} 2) Eu^{2+} 3) Yb^{2+} 4) Ce^{2+}

68. Lanthanoid contraction can be observed in
1) At 2) Gd 3) Ac 4) Lw

69. The +3 ion of which one of the following has half filled 4f subshell?
1) La 2) Lu 3) Gd 4) Ac

70. Which one of the following statements concerning Lanthanoids elements is false?
1) Lanthanoids are separated from one another by ion exchange methods
2) The ionic radii of trivalent Lanthanoids steadily increase with increase in atomic number
3) All Lanthanoids are highly dense metals
4) Most typical oxidation of Lanthanoids is +3

NEET PREVIOUS YEARS QUESTIONS

1. Which one of the following ions exhibits d-d transition and paramagnetism as well? **[2018]**
1) CrO_4^{2-} 2) $Cr_2O_7^{2-}$ 3) MnO_4^{2-} 4) MnO_4^{-}

2) Match the metal ions given in Column I with the spin magnetic moments of the ions given in Column II and assign the correct code **[2018]**

Column I		Column II	
(A)	Co^{3+}	(i)	$\sqrt{8}$ BM
(B)	Cr^{3+}	(ii)	$\sqrt{35}$ BM
(C)	Fe^{3+}	(iii)	$\sqrt{3}$ BM
(D)	Ni^{2+}	(iv)	$\sqrt{24}$ BM
		(v)	$\sqrt{15}$ BM

	(A)	(B)	(C)	(D)
(a)	(iv)	(v)	(ii)	(i)
(b)	(i)	(ii)	(iii)	(iv)
(c)	(iii)	(v)	(i)	(ii)
(d)	(iv)	(i)	(ii)	(iii)

3. Name the gas that can readily decolourise acidified $KMnO_4$ solution : **[2017]**
1) SO_2 2) NO_2 3) P_2O_5 4) CO_2

4. $HgCl_2$ and I2 both when dissolved in water containing I ions the pair of species formed is : **[2017]**
1) HgI_2, I^- 2) HgI_4^{2-}, I_3^- 3) Hg_2I_2, I^- 4) HgI_2, I_3^-

5. The reason for greater range of oxidation states in actinoids is attributed to : **[2017]**
1) Actinoid contraction. 2) 5*f*, 6*d* and 7*s* levels having comparable energies.
3) 4*f* and 5*d* levels being close in energies. 4) The radioactive nature of actinoids.

6. Which one of the following statements is correct when SO_2 is passed through acidified $K_2Cr_2O_7$ solution? **[2016]**
1) The solution turns blue. 2) The solution is decolourized.
3) SO_2 is reduced. 4) Green $Cr_2(SO_4)_3$ is formed.

7. The electronic configurations of Eu(Atomic No. 63), Gd (Atomic No. 64) and Tb (Atomic No. 65) are **[2016]**

1) $[Xe]4f^7 6s^2$, $[Xe]4f^8 6s^2$ and $[Xe]4f^8 5d^1 6s^2$ 2) $[Xe]4f^7 5d^1 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^9 6s^2$
3) $[Xe]4f^6 5d^1 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^8 5d^1 6s^2$ 4) $[Xe]4f^7 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^9 6s^2$

8. Gadolinium belongs to 4*f* series. It's atomic number is 64. Which of the following is the correct electronic configuration of gadolinium? **[2015]**

1) $[Xe]4f^8 6d^2$ 2) $[Xe]4f^9 5s^1$ 3) $[Xe]\ 4f^7 5d^1 6s^2$ 4) $[Xe]\ 4f^6 5d^2 6s^2$

9. Which of the following processes does not involve oxidation of iron? **[2015]**

1) Decolourization of blue $CuSO_4$ solution by iron.
2) Formation of $Fe(CO)_5$ from Fe.
3) Liberation of H_2 from steam by iron at high temperature.
4) Rusting of iron sheets.

10. Because of lanthanoid contraction, which of the following pairs of elements have nearly same atomic radii ? (Numbers in the parenthesis are atomic numbers). **[2015]**

1) Zr (40) and Nb (41) 2) Zr (40) and Hf (72) 3) Zr (40) and Ta (73) 4) Ti (22) and Zr (40)

11. The reaction of aqueous $KMnO_4$ with H_2O_2 in acidic conditions gives: **[2014]**

1) Mn^{4+} and O_2 2) Mn^{2+} and O_2 3) Mn^{2+} and O_3 4) Mn^{4+} and MnO_2

12. Magnetic moment 2.83 BM is given by which of the following ions? **[2014]**
(At. nos. Ti = 22, Cr = 24, Mn = 25, Ni = 28):-

1) Ti^{3+} 2) Ni^{2+} 3) Cr^{3+} 4) Mn^{2+}

13. Reason of lanthanoid contraction is:- **[2014]**

1) Negligible screening effect of '*f*' orbitals. 2) Increasing nuclear charge.
3) Decreasing nuclear charge. 4) Decreasing screening effect.

14. The manganate and permanganate ions are tetrahedral, due to **[2019]**

(1) The p.bonding involves overlap of p.orbitals of oxygen with d.orbitals of manganese
(2) There is no p.bonding
(3) The p.bonding involves overlap of p.orbitals of oxygen with p.orbitals of managanese
(4) The p.bonding involves overlap of d.orbitals of oxygen with d.orbitals of manganese

15. When neutral or faintly alkaline KMnO4 is treated with potassium iodide, iodide ion is converted into 'X'. 'X' is- **[2019-ODISSA]**

(1) I_2 (2) IO_4^- (3) IO_3^- (4) IO^-

16. Identify the incorrect statement from the following:- **[2020-Covid-19]**

(1) Zirconium and Hafnium have identical radii of 160 pm and 159 pm, respectively as a consequence of lanthanoid contraction.
(2) Lanthanoids reveal only +3 oxidation state.
(3) The lanthanoidions other than the f0 type and the f^{14} type are all paramagnetic.
(4) The overall decrease in atomic and ionic radii from lanthanum to lutetium is called lanthanoidcontraction.

17. Match the following aspects with the respective metal. **[2020-Covid-19]**

Aspects	**Metal**
(a) The metal which reveals a maximum number of oxidation states	(i) Scandium
(b) The metal although placed in 3d block is considered not as a transition element	(ii) Copper
(c) The metal which does not exhibit variable oxidation states	(iii) Manganese
(d) The metal which in +1 oxidation state in aqueous solution undergoes disproportionation	(iv) Zinc

Select the correct option :

(1) (a)-(i) (b)-(iv) (c)-(ii) (d)-(iii) (2) (a)-(iii) (b)-(iv) (c)-(i) (d)-(ii)
(3) (a)-(iii) (b)-(i) (c)-(iv) (d)-(ii) (4) (a)-(ii) (b)-(iv) (c)-(i) (d)-(iii)

18. Urea reacts with water to form A which will decompose to form B. B when passed through Cu^{2+} (aq), deep blue colour solution C is formed. What is the formula of C from the following? . **[2020]**

1) $CuCO_3Cu(OH)_2$ 2) $CuSO_4$ 3) $[Cu(NH_3)_4]^{2+}$ 4) $Cu(OH)_2$

19. Identify the incorrect statement. . **[2020]**

1) The oxidation states of chromium in CrO_4^{2-} and $Cr_2O_7^{2-}$ are not the same

2) $Cr^{2+}\left(d^4\right)$ is a stronger reducing agent than $Fe^{2+}\left(d^6\right)$ in water

3) The transition metals and their compounds are known for their catalytic activity due to their ability to adopt multiple oxidation states and to form complexes

4) Interstitial compounds are those that are formed when small atoms like H, C or N are trapped inside the crystal lattices of metals

20. The incorrect statement among the following is **[NEET-2021]**

1) Most of the trivalent Lanthanoid ions are colorless in the solid state
2) Lanthanoids are good conductors of heat and electricity
3) Actinoids are highly reactive metals, especially when finely divided
4) Actinoid contraction is greater for element to element than Lanthanoid contraction

21. Gadolinium has a low value of third ionization enthalpy because of **[NEET-2022]**

1) small size
2) high exchange enthalpy
3) high electronegativity
4) high basic character

22. In the neutral or faintly alkaline medium, $KMnO_4$ oxidises iodide into iodate. The change in oxidation state of manganese in this reaction is from **[NEET-2022]**

1) +7 to +4
2) +6 to +4
3) +7 to +3
4) +6 to +5

NCERT LINE BY LINE QUESTIONS – ANSWERS

(1.)	a	**(2.)**	c	**(3.)**	d	**(4.)**	a	**(5.)**	b
(6.)	a	**(7.)**	d	**(8.)**	d	**(9.)**	d	**(10.)**	b
(11.)	d	**(12.)**	a	**(13.)**	a	**(14.)**	c	**(15.)**	d
(16.)	d	**(17.)**	d	**(18.)**	b	**(19.)**	c	**(20.)**	a
(21.)	b	**(22.)**	d	**(23.)**	d	**(24.)**	d	**(25.)**	d
(26.)	a	**(27.)**	c	**(28.)**	c	**(29.)**	c	**(30.)**	d
(31.)	d	**(32.)**	b	**(33.)**	c	**(34.)**	a	**(35.)**	a
(36.)	c	**(37.)**	a	**(38.)**	d	**(39.)**	b	**(40.)**	a
(41.)	b	**(42.)**	a	**(43.)**	a	**(44.)**	d	**(45.)**	a
(46.)	d	**(47.)**	c	**(48.)**	a	**(49.)**	a	**(50.)**	d

TOPIC WISE PRACTICE QUESTIONS - ANSWERS

1) 3	2) 4	3) 3	4) 3	5) 1	6) 1	7) 4	8) 4	9) 2	10) 1
11) 1	12) 1	13) 3	14) 1	15) 3	16) 3	17) 3	18) 3	19) 1	20) 4
21) 4	22) 3	23) 4	24) 2	25) 4	26) 3	27) 1	28) 2	29) 2	30) 2
31) 4	32) 3	33) 1	34) 2	35) 1	36) 2	37) 1	38) 1	39) 1	40) 2
41) 3	42) 1	43) 2	44) 3	45) 1	46) 2	47) 3	48) 2	49) 3	50) 4
51) 4	52) 1	53) 4	54) 2	55) 4	56) 2	57) 1	58) 1	59) 3	60) 4
61) 4	62) 3	63) 2	64) 2	65) 3	66) 1	67) 3	68) 2	69) 3	70) 2

NEET PREVIOUS YEARS QUESTIONS-ANSWERS

1) 3	2) 1	3) 1	4) 2	5) 2	6) 4	7) 4	8) 3	9) 2	10) 2
11) 2	12) 2	13) 1	14) 1	15) 3	16) 2	17) 2	18) 3	19) 1	20) 1
21) 2	22) 1								

NCERT LINE BY LINE QUESTIONS – SOLUTIONS

(2.) (c)

$$5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$$

$$5S^{2-} + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5S$$

$$5NO_2^- + 2MnO_4^- + 6H^+ \rightarrow 2Mn^{2+} + 5NO_3^- + 3H_2O$$

(5.) (b) The elements of group 11 are still worthy of being called the coinage metals, although Ag and Au are restricted to collection items and the contemporary UK “copper” coins are copper coated steel. The ‘silver’ UK coins are a Cu / Ni alloy.

(6.) (a) Promethium (Pm) is radioactive.

$Eu^{2+} : [Xe]4f^7$

$Gd^{3+} : [Xe]4f^7$

$La^{3+} : [Xe]4f^0$

(7.) (d) Due to involvement of d-electrons in metallic bonding copper has higher melting point.

(8.) (d) $6KCl + K_2Cr_2O_7 + 7H_2SO_4 \rightarrow 4K_2SO_4 + Cr_2(SO_4)_3 + 3Cl_2 + 7H_2O$

(9.) (d) All the given statements are correct.

(10.) (b) The electronic configuration of $Cu(II)$ is $3d^9$ whereas that of $Cu(I)$ is $3d^{10}$ but $Cu(II)$ is more stable than $Cu(I)$.

(11.) (d) The highest oxidation state of osmium is $+8$ and it is a $5d$ - block element.

(12.) (a)

(15.) (d) The ability of oxygen to stabilise the high oxidation state is due to the formation of multiple bonds to metals which fluorine cannot do.

(16.) (d) All the three given terms are responsible for value of ionisation enthalpy.

(17.) (d) Co^{2+} **[Ar]** $3d^7$ unpaired electrons 3

Cr^{2+} : **[Ar]** $3d^4$ unpaired electrons 4

Mn^{2+} : **[Ar]** $3d^5$ unpaired electrons 5

Cr^{3+} : $[Ar]3d^3$ unpaired electrons 3

As Co^{2+} and Cr^{3+} have same number of unpaired electrons hence have same magnetic moment value.

(18.) (b) $$K_2Cr_2O_7 + 4NaCl + 6H_2SO_4 \rightarrow 2KHSO_4 + 4NaHSO_4 + \underset{\text{Orange red vapour}}{2CrO_2Cl_2} + 3H_2O$$

Chromyl chloride vapours when passed through NaOH solution gives a yellow solution of Na_2CrO_4.

(19.) (c) There is a greater range of oxidation states, which is in part attributed to the fact that the 5f, 6d and 7s levels are of comparable energies.

(20.) (a) General electronic configuration of lanthanoids is $(n-2)f^{1-14}(n-1)s^2p^6d^{0-1}ns^2$

(21.) (b) Both the given statements are correct.

(22.) (d)

(23.) (d) Am is an actinoid it shows more oxidation states than lanthanoids.

(25.) (d) Reaction between $KMnO_4$ and oxalic acid is

$$2KMnO_4 + 5C_2H_2O_4 + 3H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O$$

The reaction is slow in the starting but Mn^{2+} acts as an autocatalyst and speed up the reaction.

(27.) (c) Hydrochloric acid attacks almost all metals but most are slightly affected by nitric acid owing to the formation of protective oxide layers.

(29.) (c) Due to lanthanoid contraction the second and third d-series exhibit similar radii (Zr 160 pm, Hf 159 pm) and have very similar physical and chemical properties.

(30.) (d) In neutral or faintly alkaline solutions, I^- is converted to IO_3^-

$$2MnO_4^- + H_2O + I^- \rightarrow 2MnO_4 + 2OH^- + IO_3^-$$

(31.) (d) $Eu(63):[Xe]4f^7 6s^2$

$Gd(64):[Xe]4f^7 5d^1 6s^2$

$Tb(65):[Xe]4f^9 6s^2$

(32.) (b) Acidified potassium dichromate will oxidise iodides to iodine, sulphides to sulphur, ĩin (II) to tin (IV) and iron (II) salts to iron (III)

(33.) (c) Electronic configuration of $Fe(27) \rightarrow [Ar]3d^6 4s^2$

Electronic configuration of $Fe^{2+} \rightarrow [Ar]3d^6$ Thus it has 4 unpaired electrons.

Magnetic moment $= \sqrt{n(n+2)}$

$$= \sqrt{4(4+2)} = \sqrt{24} = 4.89\text{B.M.}$$

(34.) (a) Acidified $KMnO_4$ changes Fe^{2+} to Fe^{3+}

Dark purple crystals: $KMnO_4$

Green compound formed by fusing KOH with $MnO_2 : K_2MnO_4$

Orange crystals with tetrahedral structure: $K_2Cr_2O_7$

(35.) (a) $KMnO_4$ is a strong oxidising agent and its oxidising power is used for bleaching action.

(36.) (c) The first few members are quite reactive just like calcium. However with increasing atomic number, their behaviour becomes similar to that of aluminum.

(37.) (a) Ti^+ ions are more stable than Ti^{3+} and thus Ti^{3+} ions change to Ti^+ thereby acting as oxidising agents.

(39.) (b) 4f electrons shield each other from the nuclear charge quite poorly because of the very diffused shapes of f - orbitals.

(40.) (a) Cr_2O_3 and V_2O_5 are amphoteric.

(41.) (b) Mischmetal consists of a lanthanoid metal (-95%) andiron (-5%) and traces of S, C, Ca and Al.

(42.) (a) $\overset{+6}{MnO_4^{2-}} \rightarrow \overset{+7}{MnO_4^{-}} + \overset{+4}{MnO_2}$

As in this reaction Mn get reduced and oxidised both. Thus, it is a disproportionation reaction.

(43.) (a) $U(92)$: $[Rn]\ 5f^3 6d^1 7s^2$

$Pa(91)$: $[Rn] 5f\, 6d^1 7s^2$

$Cm(96)$: $[Rn]\ 5f^7 6d^1 7s^2$

$Th(90)$: $[Rn]\ 6d^2 7s^2$

$Fm(100)$: $[Rn]\ 5f^{12} 7s^2$

$Md(101)$: $[Rn]\ 5f^{13} 7s^2$

$No(102)$: $[Rn]\ 5f^{14} 7s^2$

(44.) (d) $Fe^{3+}(d^5)$ compounds are more stable than $Fe^{2+}(d^6)$ due to extra stable half-filled electronic configuration.

(45.) (a)

(47.) (c) In acidic medium $KMnO_4$ oxidises S^2 to S as:

$$5S^{2-} + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5S$$

(48.) (a) The factor responsible for lanthanoid contraction is the imperfect shielding effect of f-orbitals. The shielding of one 4f electron by another is less than that of one d-electron by another and as nuclear charge increases along the series, there is fairly regular decrease (lanthanoid contraction) in size of entire $4f^n$ orbitals.

(49.) (a) Lanthanoids are used for production of alloy steel. Mg -based alloy is used to produce bullets, shell and lighter flint. Mixed oxides of lanthanoids are employed as catalysts in petroleum cracking. Some individual Ln oxides are used as phosphors in television screens.

(50.) (d) All the lanthanides are silvery white metals, and hardness increases with increasing atomic number, samarium being steel hard.

TOPIC WISE PRACTICE QUESTIONS - SOLUTIONS

1. 3) Tendency of an element to form complexes does not depend on whether the element shows variable O.S. or not.

2. 4) $M(s) \rightarrow M^{n+}(aq) + ne^-$

This changes involve sublimation, ionisation and hydration.

3. 3) First increases till the middle of period and then decreases towards the end as the atomic no. increases more the no. of unpaired e–s, more will be the melting point. As unpaired d-orbitals electron pair up, the M.P decreases There is a very small energy difference between

4. 3) Both MnO_2 and $KMnO_4$ used for the preparation of chlorine by the action of Conc. HCl

$$MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$$

$$2KMnO_4 + 16HCl \rightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$$

Chlorine is not obtained by dil HCl

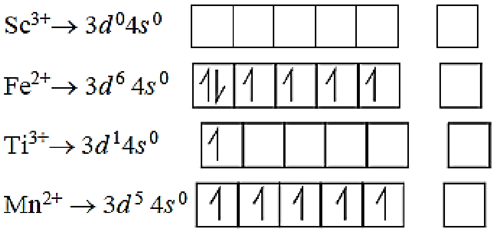
$Ag_2S_2O_3 + H_2O \rightarrow \underset{\text{Black ppt}}{Ag_2S} + H_2SO_4$

5. 1) $\mu = \sqrt{n(n+2)}$; $1.73 = \sqrt{n(n+2)}$

On calculating the value of *n* we find *n* = 1 ; No. of unpaired electrons = 1 ; hence its configuration will be $V(23) = [Ar]3d^3 4s^2$; $V^{4+} = [Ar]3d^1 4s^0$

$\therefore$ Its chloride has the formula VCl_4

6. 1)



$Sc^{3+} \rightarrow 3d^0 4s^0$
$Fe^{2+} \rightarrow 3d^6 4s^0$
$Ti^{3+} \rightarrow 3d^1 4s^0$
$Mn^{2+} \rightarrow 3d^5 4s^0$

In Sc^{3+} there is no unpaired electron. So the aqueous solution of Sc^{3+} will be colourless.

7. 4) Hg belongs to group 12.

8. 4)

ions	$E^0(V)$
Ti^{2+}	-0.37
Cr^{2+}	-0.26
Mn^{2+}	+1.57

Negative value of E° means these metals liberate hydrogen from dilute acid.

$(M^{2+} + 2H^+ - e^- \rightarrow M^{3+} + H_2)$

9. 2) In MnO_4^{2-} manganese is in +6 oxidation state which is having highest stability.

MnO_4^{2-} disproportionates in neutral or acidic solution.

$3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^{2-} + MnO_2 + 2H_2O$

10. 1)

11. 1) Mn^{2+}

12. 1)

13. 3) Due to lanthanide contraction, the size of Zr and Hf (atom and ions) become nearly similar.

14. 1) $Ti = [Ar]3d^2 4s^2$; The highest oxidation state will be +4.

15. (3) The melting points of the transition elements first rise to a maximum and then falls as the atomic number increases, manganese has abnormally low melting point.

16. 3)

$E^o_{Cu^{2+}/Cu} = 0.34\,V$

other three have – ve $E^o_{R.P.}$

$E^o_{Co^{2+}/Co} = -0.28\,V$

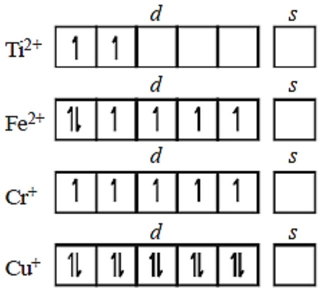
$E^o_{Ni^{2+}/Ni} = -0.25V$

$E^o_{Fe^{2+}/Fe} = -0.44V$

17. 3) The transition metals and their compounds are used as catalysts. Because of the variable oxidation states, they may form intermediate compounds with one of the reactants. These intermediates provide a new path with lower activation energy.

$V_2O_5 + SO_2 \rightarrow V_2O_4 + SO_3$; $2V_2O_4 + O_2 \rightarrow 2V_2O_5$

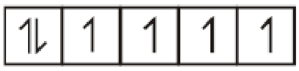
18. 3) The outer electronic configuration of the given ions is as



19. 1) The outermost electronic configuration of Fe is

$Fe = [Ar]3d^6 4s^2$

$Fe^{2+} = [Ar]3d^6 4s^0$



Since Fe^{2+} has 4 unpaired electrons it is paramagnetic in nature.

$Zn = [Ar]3d^{10} 4s^2 - \text{no unpaired } e^-$; $Hg^{2+} = [Ar]4f^{14} 5d^{10} - \text{no unpaired } e^-$

$Ti^{4+} = [Ar]3d^0 4s^0 - \text{no unpaired } e^-$

20. 4) Magetic moment $\mu = \sqrt{n(n+2)}$ where n = number of unpaired electrons $\sqrt{15} = \sqrt{n(n+1)} \therefore n = 3$

21. 4) Fe can be used to recover Cu from CuSO4 solution.

22. (3) Co^{II} Cl_2 has a blue colour in tetrahedral geometry. It changes to pink in colour with the change in coordination number to six.

23. (4) 24. (2)

25. (4) Actually zinc silver alloy gets solidified earlier than lead.

26. (3) Hg_2Cl_2 is used as a purgative in medicine.

27. (1) It is due to very high IE which results in weak metallic bonding.

28. (2) Interstitial compound Fe3C (cementite) is formed.

29. (2)

30. 2) $\overset{+4}{VO^{2+}} \square \overset{+4}{TiO^{2+}} < \overset{+5}{VO_2^+} < \overset{+6}{CrO_4^{2-}}$

31. 4) $Cr_2O_7^{2-}$, oxidation state and group number is 6.

32. 3) Mn_2O_7 is acidic, V_2O_5 is amphoteric acid and CrO is basic.

33. 1) Aqueous solution of $CoCl_2$ contains $[Co(H_2O)_6]^{2+}$ which is pinkish in colour so option 4) is incorrect. Reduction potential of $Co^{3+} \rightarrow Co^{2+}$ is high so option2) is incorrect. Co^{2+} does not oxidises easily to Co^{3+}. It is general case that symmetrical substituted octahedral complexes are less deeper in colour than tetrahedral complexes. So $[CoCl_4]^{2-}$ is deep blue in colour.

34. 2) $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag.Cu^{2+}$ will give blue solution. Cu is below in ECS than K and Zn hence no reaction will occur with them.

35. 1) CrO_2 is amphoteric in nature

36. 2) CuF_2 is both paramagnetic and coloured.

37. 1) $Cr_2O_7^{2-} + 2OH^- \rightarrow 2CrO_4^{2-} + H_2O$

38. 1) $2K_2CrO_4 + 2HNO_3 \rightarrow K_2Cr_2O_7 + 2KNO_3 + H_2O$

39. 1) $Cr_2O_7^{2-} + 6I^- + 14H^+ \rightarrow 3I_2 + 7H_2O + 2Cr^{3+}$

Oxidation state of Cr is +3

40. 2) $2CuSO_4 + 4KI \rightarrow 2K_2SO_4 + Cu_2I_2 + I_2$

41. 3) Benzene does not decolourise KMnO4 (acidic/alkaline). It is due to the delocalization of p-electron in benzene. Mohr’s salt and oxalic acid give redox reaction with KMnO4. Propene decolorises KMnO4 due to presence of C = C bond.

42. 1) The green colour appears due to the formation of

Cr^{+++} ion, i.e., $Cr_2(SO_4)_3$

$$Cr_2O_7^{2-} + 3SO_3^{2-} + 8H^+ \longrightarrow 3SO_4^{2-} + 2Cr^{3+} + 4H_2O$$

43. 2) HCl and SO_2 are reducing agents and can reduce MnO_4^-.CO_2 which is neither oxidising and nor reducing will provide only acidic medium. It can shift reaction in forward direction and reaction can go to completion.
44. (3) In laboratory, manganese (II) ion salt is oxidised to permagnate ion in aqueous solution by peroxodisulphate.
45. 1) Pyrolusite (It is MnO_2)
46. 2)
47. 3) $Mn_2O_7 \rightarrow$ acidic ; $CrO \rightarrow$ basic ; $V_2O_4 \rightarrow$ amphoteric ; $Cr_2O_3 \rightarrow$ amphoteric
48. 2) Down the group metallic character increases hence tendency to loose electron increases.
49. 3) I^- is converted to IO_3^- by neutral or faintly alkaline MnO_4^- as shown below

$$2MnO_4^- + H_2O + I^- \rightarrow 2MnO_2 + 2OH^- + IO_3^-$$

50. 4) Al^{3+} has no unpaired *d* -electrons.
51. 4) Since ionic radii decreases from La^{3+} to Lu^{3+} due to lanthanoid contraction, so La^{3+} have least ionic radii out of the given radii. Hence answer is 85 pm.
52. 1) 53. 4)
54. 2) Pm is obtained by synthetic method.
55. 4) We know that lanthanides La, Gd shows +3, oxidation state, while Eu shows oxidation state of +2 and + 3. Am shows +3, +4, +5 and +6 oxidation states. Therefore Americium (Am) has maximum number of oxidation states.
56. 2) In lanthanides, there is poorer shielding of 5*d* electrons by 4*f* electrons resulting in greater attraction of the nucleus over 5*d* electrons and contraction of the atomic radii.
57. 1) 58. 1)
59. 3) $Ac(89) = [Rn][6d^1][7s^2]$
60. 4)
61. 4) Mischmetal is an alloy which contains rare earth elements (94-95%), iron (5%) and traces of sulphur, carbon, silicon, calcium and aluminium. It is used in gas lighters, tracer bullets and shells.
62. (3) Gun metal is an alloy of Cu, Zn and Sn. It contains 88% Cu, 10% Sn and 2% Zn.
63. (2) Brass is an alloy of Cu and Zn
64. (2) Cu, Ag and Au are called coinage metals.
65. (3)
66. (1) La (lanthanum) is non lanthanoid atom.
67. 3)

$Sm^{2+}(Z=62)$

$[Xe]4f^6\ 6s^2 - 6$ unpaired e^- $Eu^{2+}(Z=63)$

$[Xe]4f^7\ 6s^2 - 7$ unpaired e^- $Yb^{2+}(Z=70)$

$[Xe]4f^{14}\ 6s^2 - 0$ unpaired e^- $Ce^{2+}(Z=58)$

$[Xe]4f^1\ 5d^1\ 6s^2 - 2$ unpaired e^-

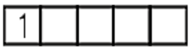
Only Yb^{2+} is diamagnetic.

68. (2) Amongst the given elements, only Gd is a lanthanide.
69. (3)
70. (2) Ionic radii of trivalent lanthanoides decreases progressively with increase in atomic no. due to lanthanoides contraction.

NEET PREVIOUS YEARS QUESTIONS-EXPLANATIONS

1. 3)

CrO_4^{2-}	Cr^{6+} diamagnetic
$Cr_2O_7^{2-}$	Cr^{6+} diamagnetic
MnO_4^-	Mn^{7+} diamagnetic
MnO_4^{2-}	Mn^{6+} paramagnetic



Thus unpaired electron is present, so *d*–*d* transition is possible.

2. 1) $Co^{3+} = [Ar]3d^6$, unpaired $e^-(n) = 4$

Spin magnetic moment = $\sqrt{4(4+2)} = \sqrt{24}$ B.M

$Cr^{3+} = [Ar]3d^3$, unpaired $e^-(n) = 3$

Spin magnetic moment $= \sqrt{3(3+2)} = \sqrt{15}$ B.M

$Fe^{3+} = [Ar]3d^5$, unpaired $e^-(n) = 5$

Spin magnetic moment $= \sqrt{5(5+2)} = \sqrt{35}$ B.M

$Ni^{2+} = [Ar]3d^8$, unpaired $e^-(n) = 2$

Spin magnetic moment $\sqrt{2(2+2)} = \sqrt{8}$ B.M

3) 1) Potassium permanganate has a purple colour. When sulphur dioxide reacts with potassium permanganate the solution decolourizes.

$$5SO_2 + 2KMnO_4 + 2H_2O \rightarrow 2H_2SO_4 + 2MnSO_4 + K_2SO_4$$

4) 2) In a solution containing $HgCl_2, I_2$ and I^-, both $HgCl_2$ and I_2 compete for I^-

Since formation constant of $[HgI_4]^{2-}$ is very large

(1.9×10^{30}) as compared with $I_3\ (K_f = 700)$

$\therefore I^-$ will preferentially combine with $HgCl_2$

$$\underset{}{HgCl_2 + 2I^- \rightarrow} \underset{\text{Red ppt}}{HgI_2\downarrow} + 2Cl^-$$

$$HgI_2 + 2I^- \rightarrow \underset{\text{soluble}}{[HgI_4]^{2-}}$$

5. 2) Minimum or comparable energy gap between 5*f*, 6*d* and 7*s* subshell makes electron excitation easier, hence there is a greater range of oxidation states in actinoids.

6. 4) $K_2Cr_2O_7 + SO_2 + H_2SO_4 \rightarrow K_2SO_4 + \underset{\text{Green colour}}{Cr_2(SO_4)_3} + H_2O$

7. 4)

$Eu(63) = [Xe]4f^7 6s^2$

$Gd(64) = [Xe]4f^7 5d^1 6s^2$

$Tb(65) = [Xe]4f^7 5d^1 6s^2$

8. 3) $Gd(64) = [Xe]4f^7 5d^1 6s^2$

9. (2) Formation of Fe(CO)5 from Fe involves no change in oxidation state of iron.

10. (2) Due to lanthanoid contraction atomic radii of Zr and Hf is almost similar.

11. 2) $2KMnO_4 + 3H_2SO_4 + 5H_2O_2 \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$ i.e. Mn^{2+} ion and O_2

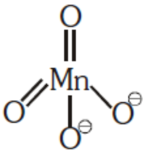
12. 2) Magnetic moment

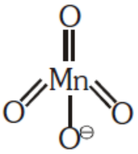
$\mu = \sqrt{n(n+2)}$; 2.83 = $\sqrt{n(n+2)}$; On solving n = 2

Ni^{2+} have two unpaired electron.

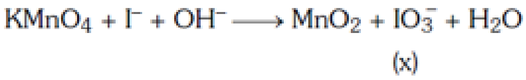
13. 1) The shape of *f*-orbitals is very much diffused and they have poor shielding effect. The effective nuclear charge increases which causes the contractiion in the size of electron charge cloud. This contraction in size is quite
regular and known as lanthanoid contraction.

14. 1) MnO_4^{-2} (Mangnate ion) and MnO_4^- (Permangnate ion) both are tetrahedral





Since ' π ' bond is formed between p-orbital of oxygen and d-orbital of Managnese



$$KMnO_4 + I^- + OH^- \longrightarrow MnO_2 + \underset{(x)}{IO_3^-} + H_2O$$

15. 3)

16. 2) Lanthanoids shows general oxidation state +3 butsome elements can shows +2 as well as +4.

17. 2) In the given options
The metal which reveals a maximum number of oxidation state → Mn
The metal although placed in 3d block is considered not as a transition element is → Zn
The metal which does not exhibit variable oxidation state is → Sc (only +3)
The metal which in +1 oxidation state in aqueous solution undergoes disproportionation is → Cu

18. 3) $Cu^{2+} + 4NH_3 \rightarrow \left[Cu\left(NH_3\right)_4\right]^{2+}$ deep blue colour

19. 1)In both CrO_4^{2-} and $Cr_2O_7^{2-}$ oxidation state of chromium is +6

$Cr^{2+} \rightarrow Cr^{3+}$ $\quad Fe^{+2} \rightarrow Fe^{+3}$;

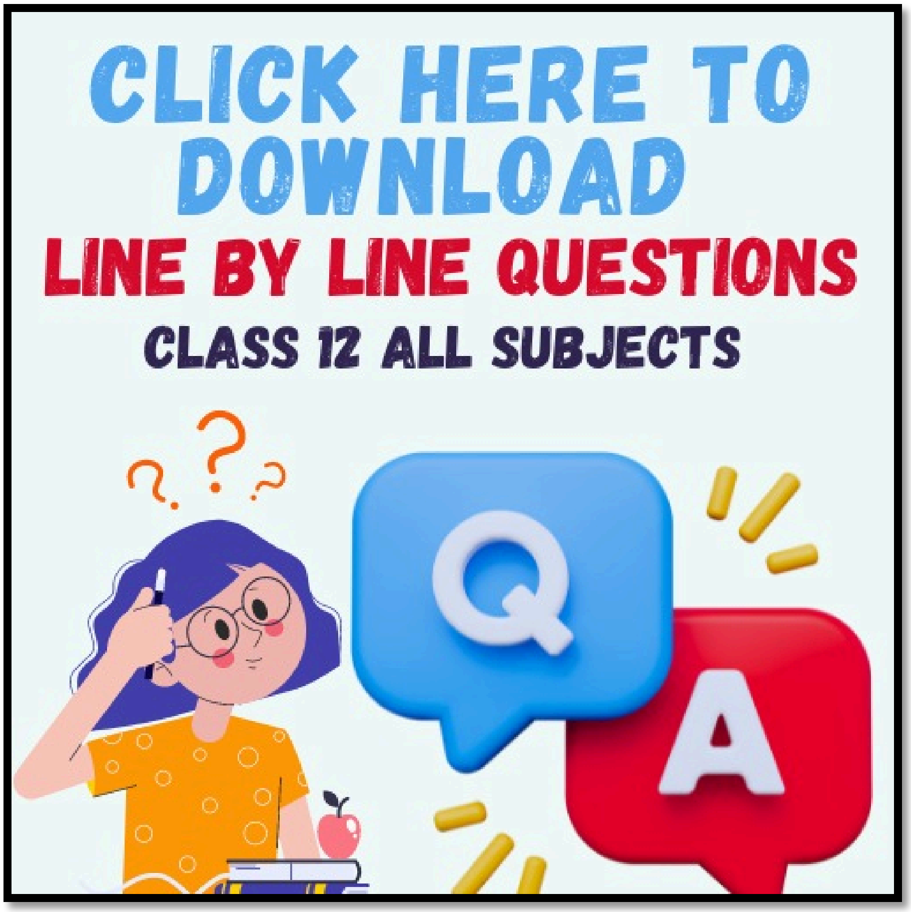
$3d^4$ $\quad 3d^3$ $\quad 3d^6$ $\quad 3d^5$

Cr^{3+} has more stable t_2g^3 configuration

20. 1)Actinoids are highly reactive metals, especially when finely divided
Actinoid contraction is greater from element to element than lanthanoid contraction resulting from poor shielding by 5f electrons
Many trivalent lanthanoids ions are coloured both in the solid state and in aqueous solutions.
Lanthanoids have typical metallic structure and are good conductors of heat and electricity

21. By the loss of 3 electrons from $5d^1$ and $6s^2$, it gets stable half-filled $4f^7$ configuration

22. Faintly alkaline medium or neutral
$KMnO_4 \rightarrow K_2MnO_4 \quad MnO_2$
+7 to + 4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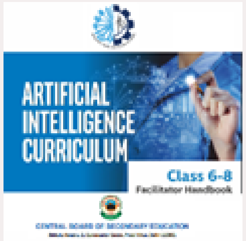
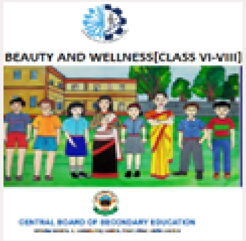
SKILL MODULES BEING OFFERED IN MIDDLE SCHOOL


ARTIFICIAL INTELLIGENCE CURRICULUM
Class 6-8
Facilitator Handbook
CENTRAL BOARD OF SECONDARY EDUCATION

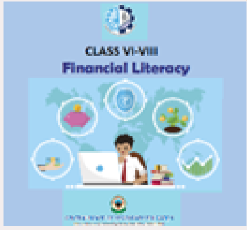
Artificial Intelligence


BEAUTY AND WELLNESS[CLASS VI-VIII]
CENTRAL BOARD OF SECONDARY EDUCATION

Beauty & Wellness

DESIGN THINKING&INNOVATION
CLASS VI-VIII
CENTRAL BOARD OF SECONDARY EDUCATION

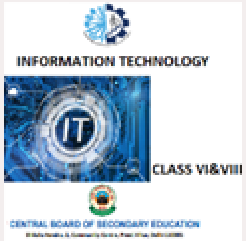
Design Thinking & Innovation


CLASS VI-VIII
Financial Literacy

Financial Literacy

HANDICRAFTS
CLASS VI-VIII
CENTRAL BOARD OF SECONDARY EDUCATION

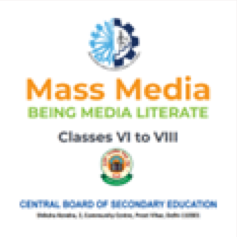
Handicrafts


INFORMATION TECHNOLOGY
CLASS VI&VIII
CENTRAL BOARD OF SECONDARY EDUCATION

Information Technology

MARKETING
Class VI - VIII
CENTRAL BOARD OF SECONDARY EDUCATION

Marketing/Commercial Application


Mass Media
BEING MEDIA LITERATE
Classes VI to VIII
CENTRAL BOARD OF SECONDARY EDUCATION

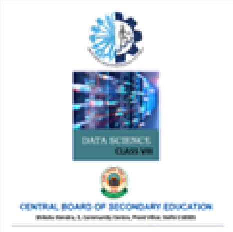
Mass Media - Being Media Literate

TRAVEL & TOURISM
CLASS VI-VIII
CENTRAL BOARD OF SECONDARY EDUCATION

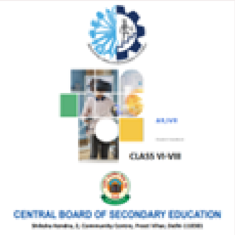
Travel & Tourism

CODING
CLASS VI-VIII

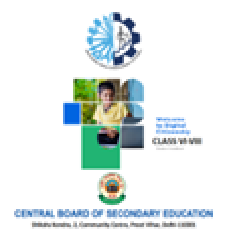
Coding


DATA SCIENCE
CLASS VIII
CENTRAL BOARD OF SECONDARY EDUCATION

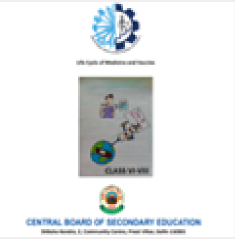
Data Science (Class VIII only)


CLASS VI-VIII
CENTRAL BOARD OF SECONDARY EDUCATION

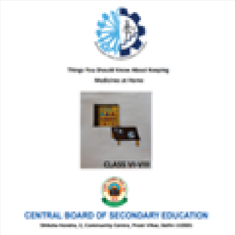
Augmented Reality / Virtual Reality


CLASS VI-VIII
CENTRAL BOARD OF SECONDARY EDUCATION

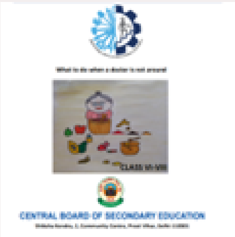
Digital Citizenship


CLASS VI-VIII
CENTRAL BOARD OF SECONDARY EDUCATION

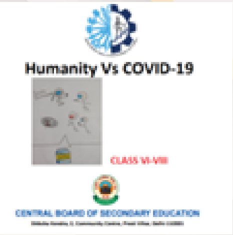
Life Cycle of Medicine & Vaccine


CLASS VI-VIII
CENTRAL BOARD OF SECONDARY EDUCATION

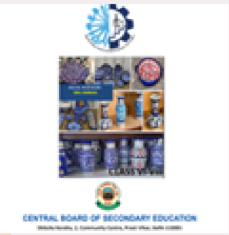
Things you should know about keeping Medicines at home


CLASS VI-VIII
CENTRAL BOARD OF SECONDARY EDUCATION

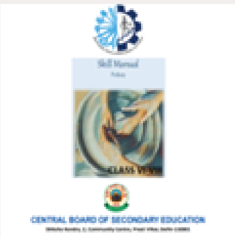
What to do when Doctor is not around


Humanity Vs COVID-19
CLASS VI-VIII
CENTRAL BOARD OF SECONDARY EDUCATION

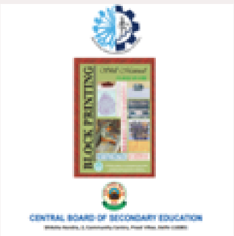
Humanity & Covid-19


CLASS VI-VIII
CENTRAL BOARD OF SECONDARY EDUCATION

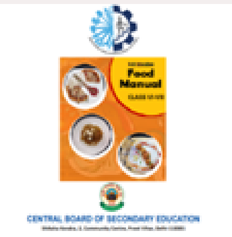
Blue Pottery

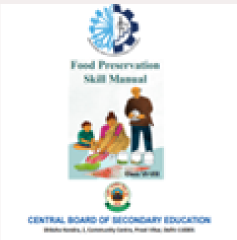

Skill Manual
CLASS VI-VIII
CENTRAL BOARD OF SECONDARY EDUCATION

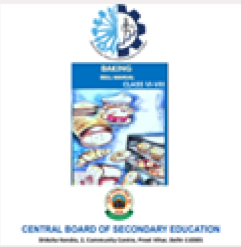
Pottery

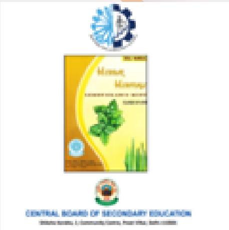

BLOCK PRINTING
CENTRAL BOARD OF SECONDARY EDUCATION

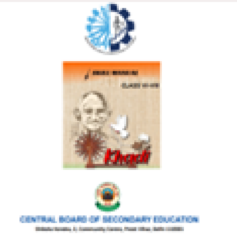
Block Printing

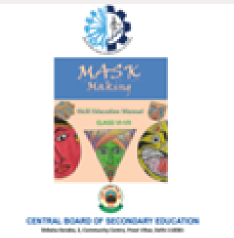

Food

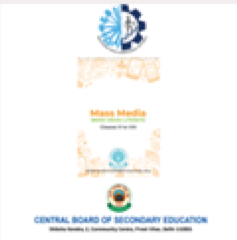

Food Preservation


Baking

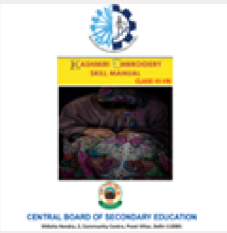

Herbal Heritage


Khadi

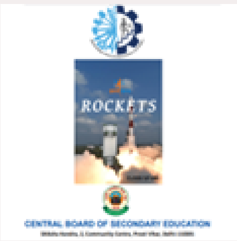

Mask Making

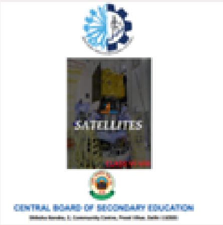

Mass Media

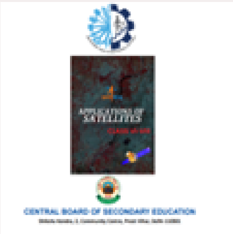
Making of a Graphic Novel

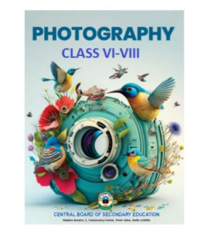

Kashmiri Embroidery

Embroidery

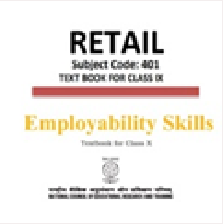

Rockets


Satellites

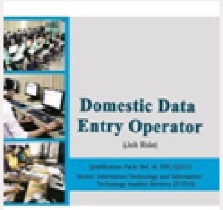

Application of Satellites


Photography

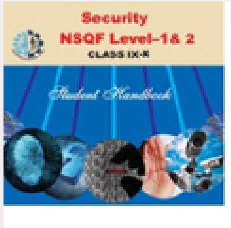
SKILL SUBJECTS AT SECONDARY LEVEL (CLASSES IX – X)


RETAIL
Subject Code: 401
TEXT BOOK FOR CLASS IX
Employability Skills
Textbook for Class X

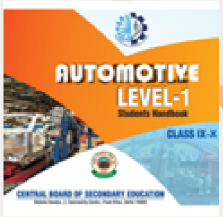
Retail


Domestic Data Entry Operator
(Job Role)

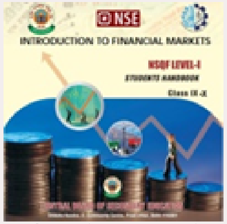
Information Technology


Security
NSQF Level-1& 2
CLASS IX-X
Student Handbook

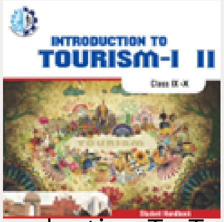
Security


AUTOMOTIVE
LEVEL-1
Students Handbook
CLASS IX-X
CENTRAL BOARD OF SECONDARY EDUCATION

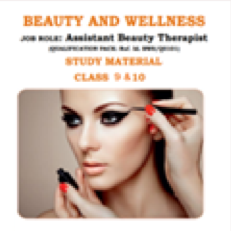
Automotive


NSE
INTRODUCTION TO FINANCIAL MARKETS
NSQF LEVEL-I
STUDENTS HANDBOOK
Class IX-X

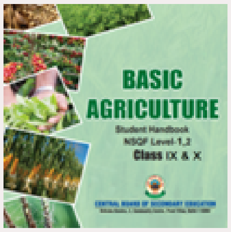
Introduction To Financial Markets


INTRODUCTION TO
TOURISM-I II
Class IX-X

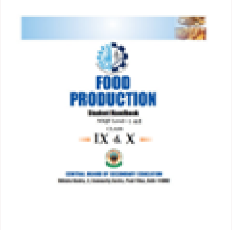
Introduction To Tourism


BEAUTY AND WELLNESS
JOB ROLE: Assistant Beauty Therapist
STUDY MATERIAL
CLASS 9 & 10

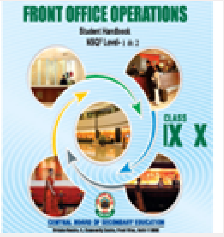
Beauty & Wellness


BASIC AGRICULTURE
Student Handbook
NSQF Level-1,2
Class IX & X

Agriculture


FOOD PRODUCTION
IX & X
CENTRAL BOARD OF SECONDARY EDUCATION

Food Production


FRONT OFFICE OPERATIONS
Student Handbook
NSQF Level-1 & 2
CLASS IX X

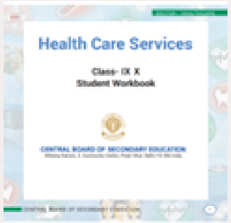
Front Office Operations

Banking & Insurance
Study Material
Standard IX & X
Student Handbook

Banking & Insurance

MARKETING AND SALES
Study Material
IX & X
Student Handbook

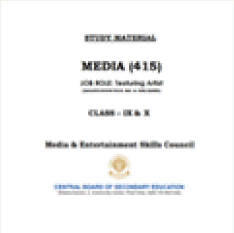
Marketing & Sales


Health Care Services
Class- IX X
Student Workbook
CENTRAL BOARD OF SECONDARY EDUCATION

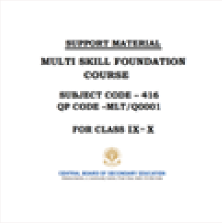
Health Care

Apparel
Hand Embroiderer
(Job Role)

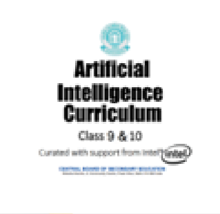
Apparel


STUDY MATERIAL
MEDIA (415)
CLASS - IX & X
Media & Entertainment Skills Council
CENTRAL BOARD OF SECONDARY EDUCATION

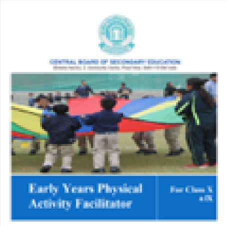
Multi Media


SUPPORT MATERIAL
MULTI SKILL FOUNDATION COURSE
SUBJECT CODE - 416
QP CODE -MLT/Q0001
FOR CLASS IX - X

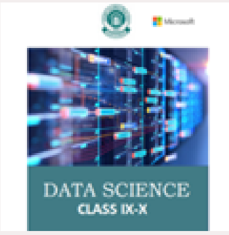
Multi Skill Foundation Course


Artificial Intelligence Curriculum
Class 9 & 10
Curated with support from intel

Artificial Intelligence


CENTRAL BOARD OF SECONDARY EDUCATION
Early Years Physical Activity Facilitator

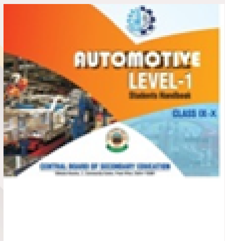
Physical Activity Trainer


Microsoft
DATA SCIENCE
CLASS IX-X

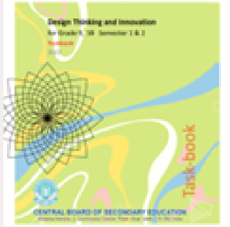
Data Science

CENTRAL BOARD OF SECONDARY EDUCATION
JOB ROLE: FIELD TECHNICIAN - OTHER HOME APPLIANCES
STUDENT TEXTBOOK
CLASS 9 & 10
Sector: ELECTRONICS AND HARDWARE

Electronics & Hardware (NEW)

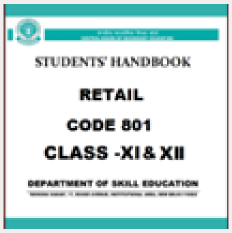

AUTOMOTIVE
LEVEL-1
Students Handbook
CLASS IX-X
CENTRAL BOARD OF SECONDARY EDUCATION

Foundation Skills For Sciences (Pharmaceutical & Biotechnology)(NEW)

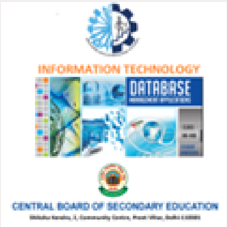

Design Thinking and Innovation
Task book
CENTRAL BOARD OF SECONDARY EDUCATION

Design Thinking & Innovation (NEW)

SKILL SUBJECTS AT SR. SEC. LEVEL (CLASSES XI – XII)


STUDENTS' HANDBOOK
RETAIL
CODE 801
CLASS -XI & XII
DEPARTMENT OF SKILL EDUCATION

Retail


INFORMATION TECHNOLOGY
DATABASE
CENTRAL BOARD OF SECONDARY EDUCATION

InformationTechnology

Web Applications
Students Handbook
CLASS
XI-XII
CENTRAL BOARD OF SECONDARY EDUCATION

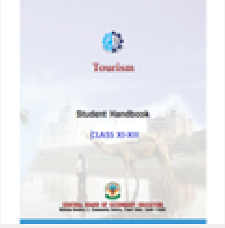
Web Application

AUTOMATIVE
CLASS XI-XII
CENTRAL BOARD OF SECONDARY EDUCATION

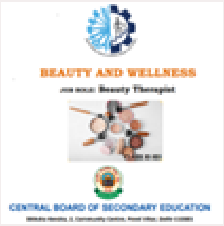
Automotive

FINANCIAL MARKETS MANAGEMENT
CLASS XI-XII
CENTRAL BOARD OF SECONDARY EDUCATION

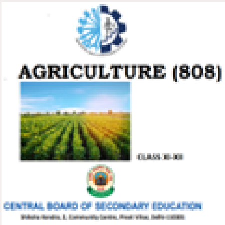
Financial Markets Management


Tourism
Student Handbook
CLASS XI-XII

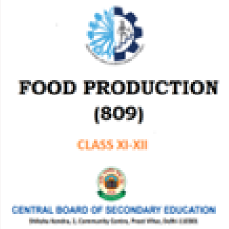
Tourism


BEAUTY AND WELLNESS
Job Role: Beauty Therapist
CENTRAL BOARD OF SECONDARY EDUCATION

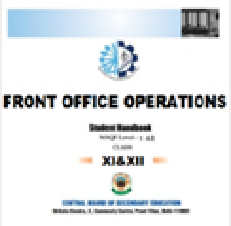
Beauty & Wellness


AGRICULTURE (808)
CLASS XI-XII
CENTRAL BOARD OF SECONDARY EDUCATION

Agriculture


FOOD PRODUCTION
(809)
CLASS XI-XII
CENTRAL BOARD OF SECONDARY EDUCATION

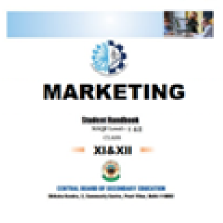
Food Production


FRONT OFFICE OPERATIONS
Student Handbook
XI&XII

Front Office Operations

BANKING
Student Handbook
XI&XII

Banking


MARKETING
Student Handbook
XI&XII

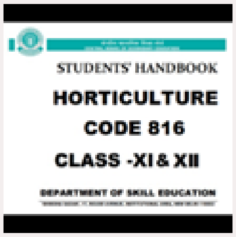
Marketing

SECTOR : HEALTHCARE
Student Workbook
CLASS XI&XII
Central Board of Secondary Education

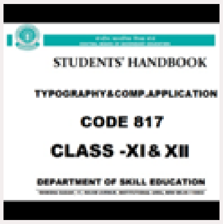
Health Care

INSURANCE
Student Handbook
XI&XII

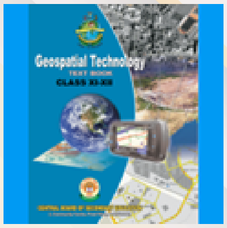
Insurance


STUDENTS' HANDBOOK
HORTICULTURE
CODE 816
CLASS -XI & XII
DEPARTMENT OF SKILL EDUCATION

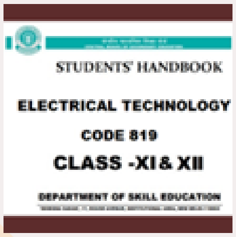
Horticulture


STUDENTS' HANDBOOK
TYPOGRAPHY&COMP.APPLICATION
CODE 817
CLASS -XI & XII
DEPARTMENT OF SKILL EDUCATION

Typography & Comp. Application


Geospatial Technology
TEXT BOOK
CLASS XI-XII

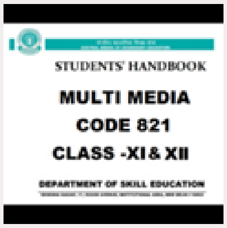
Geospatial Technology


STUDENTS' HANDBOOK
ELECTRICAL TECHNOLOGY
CODE 819
CLASS -XI & XII
DEPARTMENT OF SKILL EDUCATION

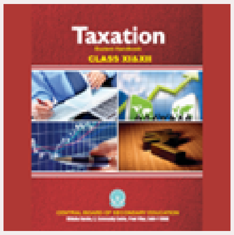
Electrical Technology

BASIC ELECTRONICS
Student Handbook
CLASS XI&XII

Electronic Technology


STUDENTS' HANDBOOK
MULTI MEDIA
CODE 821
CLASS -XI & XII
DEPARTMENT OF SKILL EDUCATION

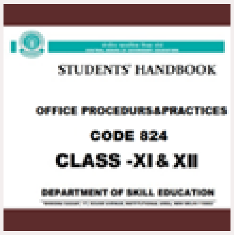
Multi-Media


Taxation
CLASS XI&XII

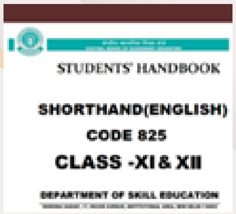
Taxation

Cost Accounting
CLASS XI&XII

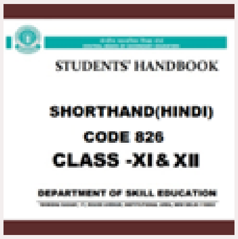
Cost Accounting


STUDENTS' HANDBOOK
OFFICE PROCEDURES&PRACTICES
CODE 824
CLASS -XI & XII
DEPARTMENT OF SKILL EDUCATION

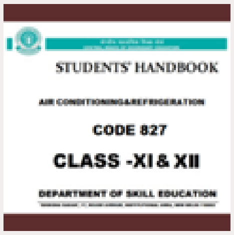
Office Procedures & Practices


STUDENTS' HANDBOOK
SHORTHAND(ENGLISH)
CODE 825
CLASS -XI & XII
DEPARTMENT OF SKILL EDUCATION

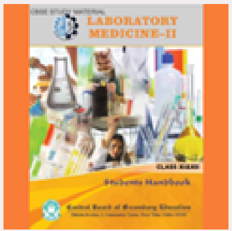
Shorthand (English)


STUDENTS' HANDBOOK
SHORTHAND(HINDI)
CODE 826
CLASS -XI & XII
DEPARTMENT OF SKILL EDUCATION

Shorthand (Hindi)


STUDENTS' HANDBOOK
AIR CONDITIONING&REFRIGERATION
CODE 827
CLASS -XI & XII
DEPARTMENT OF SKILL EDUCATION

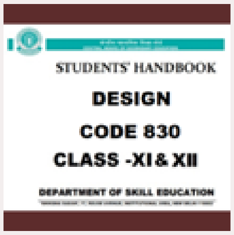
Air-Conditioning & Refrigeration


LABORATORY MEDICINE-II
CLASS XI&XII
Students Handbook
Central Board of Secondary Education

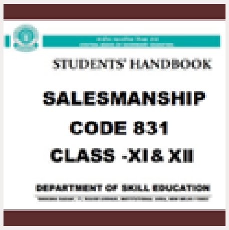
Medical Diagnostics

TEXTILE SCIENCE
Text Book & Practical Manual

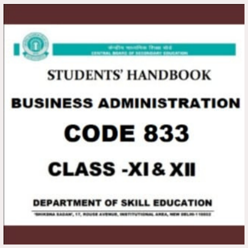
Textile Design


STUDENTS' HANDBOOK
DESIGN
CODE 830
CLASS -XI & XII
DEPARTMENT OF SKILL EDUCATION

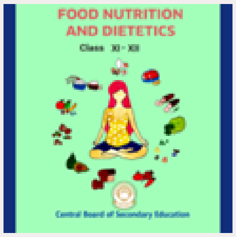
Design


STUDENTS' HANDBOOK
SALESMANSHIP
CODE 831
CLASS -XI & XII
DEPARTMENT OF SKILL EDUCATION

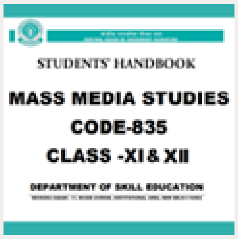
Salesmanship


STUDENTS' HANDBOOK
BUSINESS ADMINISTRATION
CODE 833
CLASS -XI & XII
DEPARTMENT OF SKILL EDUCATION

Business Administration


FOOD NUTRITION AND DIETETICS
Class XI - XII
Central Board of Secondary Education

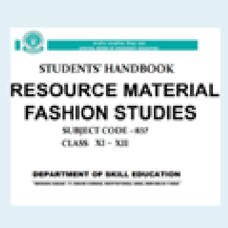
Food Nutrition & Dietetics


STUDENTS' HANDBOOK
MASS MEDIA STUDIES
CODE-835
CLASS -XI & XII
DEPARTMENT OF SKILL EDUCATION

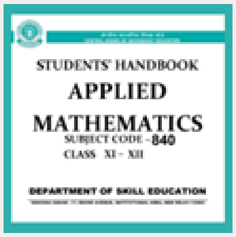
Mass Media Studies

CENTRAL BOARD OF SECONDARY EDUCATION
LIBRARY AND INFORMATION SCIENCE
CLASS XI - XII

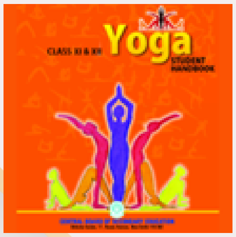
Library & Information Science


STUDENTS' HANDBOOK
RESOURCE MATERIAL
FASHION STUDIES
SUBJECT CODE - 837
CLASS XI - XII
DEPARTMENT OF SKILL EDUCATION

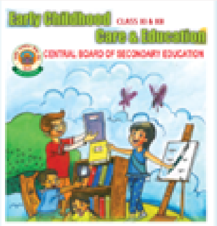
Fashion Studies


STUDENTS' HANDBOOK
APPLIED
MATHEMATICS
SUBJECT CODE - 840
CLASS XI - XII
DEPARTMENT OF SKILL EDUCATION

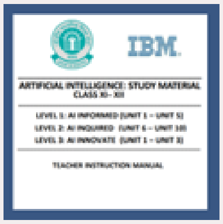
Applied Mathematics


CLASS XI & XII
Yoga
STUDENT HANDBOOK

Yoga


Early Childhood Care & Education
CLASS XI & XII
CENTRAL BOARD OF SECONDARY EDUCATION

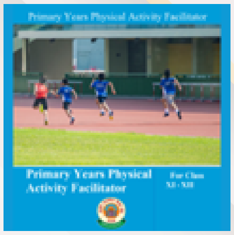
Early Childhood Care & Education


IBM.
ARTIFICIAL INTELLIGENCE: STUDY MATERIAL
CLASS XI - XII
TEACHER INSTRUCTION MANUAL

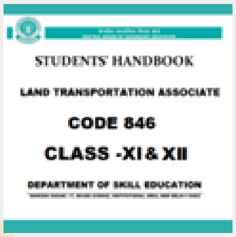
Artificial Intelligence

DATA SCIENCE
CLASS XI-XII

Data Science


Primary Years Physical Activity Facilitator
Primary Years Physical Activity Facilitator
For Class XI - XII

Physical Activity Trainer(new)


STUDENTS' HANDBOOK
LAND TRANSPORTATION ASSOCIATE
CODE 846
CLASS -XI & XII
DEPARTMENT OF SKILL EDUCATION

Land Transportation Associate (NEW)

Installation Technician Computing and Peripherals
Sector: Electronics and Hardware
CENTRAL BOARD OF SECONDARY EDUCATION

Electronics & Hardware (NEW)

Design Thinking and Innovation
Task-book

Design Thinking & Innovation (NEW)